# APPENDIX B

# VEGETATION

The following provides an explanation of the vegetation zones used in this document.

## Introduction

A classification of vegetation zones (potential vegetation) provides an information storage and retrieval system that is related to real landscape features. Potential vegetation can serve as a template for block planning and stand management because 1) the spatial limits of species distribution and abundance are defined, 2) a range of site productivity is defined, 3) species' reactions to disturbance and management action are related to a landscape unit, and 4) a map unit is created for data storage and retrieval for comparison of management actions.

Vegetation zones are large areas of the landscape that if, left to its natural process, would give rise climax vegetation with the same set of dominant species A zone is an elevation belt that has the same climax vegetation on zonal sites, e.g., Ponderosa pine would dominate in the Ponderosa pine zone. Zonal sites have gentle slope, deep, nonstony soils, moderate drainage, and average chemical characteristics (Daubenmire, 1970). Within a zone, drier or wetter sites may support different types of potential vegetation than the zonal site. These specific plant communities that reflect site variations within a vegetation zone are called plant associations. As with vegetation zones, plant associations, indicate a particular range of environments, species, and natural processes, but do not necessarily represent existing vegetation.

Community classifications do not directly address structural and temporal variability in vegetation. Structural diversity of individual stands (described by tree height and numbers, density and height of shrubs, etc.) and patterns of stands on the landscapes (described by shape, size and distribution of different stands) portray the architecture of ecosystems. Structural variability reflects species composition but more often reflects development and growth of species and the history of disturbance. Structural features are important indicators of ecosystems functions such as habitat for wildlife and many specialized lichens, mosses, and fungi.

## AN ECOLOGICAL FRAMEWORK TO CREATE MANAGEMENT OPTIONS

Understanding how forest ecosystems are constructed and how they work (function) is a prerequisite to maintaining healthy forests and managing the multiple values they hold. The biological basis of forest management is an appreciation of the processes that create the forest, their origins, structure and complex interrelationships of all its components parts. The growth of trees and viability of all forest inhabitants is a product of many interactions within the ecosystem. Within an ecological framework, a healthy forest is defined as the maintenance of healthy relationships among all the resources. As we manage forests for specific products and outcomes, the condition of a specific resource may very overtime and space but the maintenance of the ecosystems ability to support that resource should not be impaired.

The ecological framework relates the natural range of conditions for each major vegetation zones on the Loomis State forest, to the ideal characteristics of forest composition, structure and landscape composition for each resource (water, soil, air, wildlife, fish, and cultural resources). In folding together all resources using the common denominator of vegetation zone condition we have integrated resource needs on a functional basis. In tracking the vegetation condition over time in relation to the desired condition for each resource we provide accountability for the status of each resource.

### Defining the desired future condition

To reach the level of required specificity the analysis examines the 7 impacted resources (water, soil, air, wildlife, fish, cultural resources and ecosystem integrity) and the 4 impacting resources (timber harvesting, grazing, and mining), on parallel paths. All are examined in terms of their goals, objectives for the entire forest, and targets and standards stratified by vegetation community group.

The desired future condition combines the standards for each resource into a composite desired future condition for the entire ecosystem. This common vision expressed in the same terms for each resource, is used to integrate and reconcile standards for each resource by vegetation zone. This is essentially an ecosystem-level summary of the needs of all resources by the 7 vegetation zones.

### Vegetation Zones

The purpose of a plant community classification is to define areas of similar function on the landscape. The Okanogan guide to forested plant associations is based on the climax community concept were by the zone is named for the most shade tolerant tree species that occupies the site. The most favored crop species is usually a fast growing early seral species. The forest zone represents a land area of similar climate, soils, and biotic influences that determine the functioning and growth of forests. Forest zones are divided in to plant associations and are usually considered as the smallest division of an ecosystem. Plant associations are based of floristic analysis of sites within forest zones and are named for the characteristic understory vegetation that is intended to represent different growing sites reflecting changes in soil moisture and nutrient status within a forest zone.

The vegetation found on any piece of ground is a result of available flora, climate, soils, competition, herbivory, disease, and history. Each of these elements shapes the character of the vegetation by affecting its composition, vertical structure, or horizontal pattern.

The Loomis Block has seven vegetation zones. Of these, the Douglas fir and Subalpine Fir Zones are the most widespread. The other four zones occur only in limited areas of the Block. Each zone is described below.

**SHRUB STEPPE ZONE:**

The threetip sagebrush zone occurs at the lowest elevations within the Block. Communities dominated by threetip sagebrush are found on typical sites. Antelope bitterbrush and big sagebrush are common shrubs in this zone. Ponderosa pine woodland may occur on relatively moist, well-drained sites. Soils in the valley centers are very moist to subirrigated and can support a lush grassland or riparian woodland.

STRUCTURE: This zone consists of non-forested areas dominated by bunchgrasses and shrubs, and is mainly devoid of trees. Grasses and forbs generally make up the majority of vegetative cover. Shrubs often form a taller, more discontinuous layers above the herbaceous layer. Shrub cover may be greater on heavily grazed sites. Occasional trees may be widely scattered. In undisturbed condition, the ground between grasses, shrubs, and forbs is generally covered with a layer of lichens and mosses (biotic crust). Riparian areas often have dense cover of trees and/or tall shrubs.

SPECIES COMPOSITION: Dominant grasses in undisturbed condition are bluebunch wheatgrass and/or Idaho fescue. Sandberg's bluegrass is of secondary importance. With grazing disturbance, cheatgrass may be the dominant grass. Important shrub species are bitterbrush, big sagebrush, and three-tip sagebrush. Many species of forbs may be present; arrowleaf balsamroot is often the most abundant. Ponderosa pine or Douglas fir may occasionally be present in small amounts.

DISTURBANCE

A. Fire -- appears that fires are relatively frequent; fire return intervals not well known because of lack of trees for ring count analysis. The importance of cheatgrass tends to increase probability and frequency of fire by increasing fuel continuity, therefore fires are probably more frequent now than they were in pre-settlement times. Bitterbrush is killed by most fires; low-intensity spring fires may promote its sprouting (bitterbrush is much used by cattle in winter). Big sagebrush is generally killed by fire; three-tip sagebrush, bunchgrasses, and most forbs resprout after fire. If present, cheatgrass, an annual non-native species, may increase after fire.

B. Grazing -- Over-grazing tends to eliminate bunchgrasses, compact soil, and increase density of big sagebrush where present. Biotic crust (lichens/mosses) is removed or reduced by grazing (biotic crust is important to ecosystems because it fixes nitrogen and increases infiltration). Prevalence of cheatgrass and other non-native and annual species increases with grazing pressure. Grazing is most damaging to native bunchgrasses from flowering to seed ripening (about mid April-July). Riparian zones are preferentially used by cattle and are negatively affected in multiple aspects by overgrazing. Bitterbrush is heavily browsed by cattle and deer in the winter. Noxious weeds may invade with grazing, especially diffuse knapweed.

PRODUCTIVITY: Low productivity, because of low precipitation and warm temperatures. Grasses provide most of usable productivity. The major growing season for grasses and forbs is April-June, later at higher elevations. This zone has marginal conditions for tree growth. Regeneration of what few trees are present is very uncertain because of hot, dry conditions.

LANDSCAPE SETTING: Elevation 2,460 to 4,640 feet; mainly southeast to west aspects, less commonly on other aspects; slope steepness varies; slope position variable.

SOILS: Variable; soils tend to be relatively coarse-textured.

CLIMATE/MOISTURE: Hot and dry; lowest precipitation of any of the zones; moderately cold winters and warm to hot summers; effective precipitation mainly autumn through winter; soil moisture deficits common; high evapotranspiration.

The specific plant associations contained within this zone on the Loomis State forest are as follows:

threetip sagebrush/Idaho fescue
bitterbrush/Idaho fescue
bitterbrush/bluebunch wheatgrass
mountain big sagebrush (Artemisia tridentata spp. vaseyana)
big sagebrush/bluebunch wheatgrass
big sagebrush/Idaho fescue
Idaho fescue-Wyeth's buckwheat

## PONDEROSA PINE ZONE:

The ponderosa pine zone forms a narrow belt around the lowest valley bottoms in the Block. Also included in this zone is the driest of the Douglas fir vegetation zone plant associations, because their management is identical to that of ponderosa pine plant associations. Zonal vegetation is ponderosa pine woodland with bunchgrasses, such as Idaho fescue and bluebunch wheatgrass, and shrubs, such as antelope bitterbrush and snowberry. Cottonwood and aspen may occur near water. Dry sites within this zone have big sagebrush or threetip sagebrush communities. Because this is the lowest forest or woodland zone, tree regeneration can be difficult.

STRUCTURE: In pre-settlement conditions (frequent fires), these forests were very open and park-like in structure, with small groups of even-aged trees dominating the canopy in a patchy fashion. Stands were uneven-aged at the forest level, but even-aged at the small patch level (1 acre or less). The understory is dominated by grasses and, to a lesser degree, by a discontinuous shrub layer. Biotic crust (as in the steppe zone) may be a prominent feature where bunchgrasses dominate the understory. Density of trees has increased on some of these sites in the last 80 years due to fire suppression and other management activities, and the open, park-like structure has consequently given way to more closed structural conditions with an abundance of younger trees. Overstory canopy cover is generally less than 50% in old stands, and may be much lower.

SPECIES COMPOSITION: Trees are almost exclusively ponderosa pine and Douglas fir. On the warmest and driest sites within this zone, Douglas fir is absent. Ponderosa pine tends to predominate among older trees; Douglas fir tends to predominate (when present) in the younger age classes. On many sites, both species appear capable of regenerating indefinitely. Bluebunch wheatgrass and Idaho fescue are the dominant native grasses, with pinegrass important also on the more mesic sites within the zone. Cheatgrass is a major increaser with grazing that may dominate the understory. The most abundant shrub is bitterbrush; bearberry is important on the coolest, most mesic sites within the zone. Snowbrush and buffaloberry may be important after fire on the relatively cool, mesic sites. Arrowleaf balsamroot is the most abundant forb; many other species may be present, with strong floristic similarities to the steppe zone. In many ways, this zone is a steppe with an open-canopy tree layer added.

DISTURBANCE:

A. Fire -- Fire regime characterized by frequent, low-severity fires (low-severity fire regime - Agee 1993). Typical pre-settlement fire return intervals were 5-30 years. The low-severity fires tended to kill small trees, especially Douglas fir, and favor dominance by the fire-resistant ponderosa pine. Fires helped to maintain the open, park-like structure and the grassy understory by limiting the importance of small, young trees. Young trees were primarily limited to the small patches where old trees had recently died. Bitterbrush is killed by most fires, but may resprout after low-intensity spring fire. Most grasses, forbs, and other shrubs resprout after fire. Current conditions of more dense, younger stands in many areas tend to result in more intense, high-severity fire when fires do occur.

B. Disease -- Dwarf mistletoe is abundant in Douglas fir.

Dwarf mistletoe is a parasitic plant which seeds onto tree branches, distorting growth, weakening and eventually killing infested trees. Each major commercial conifer species is infested with a different dwarf mistletoe species. Treatment of dwarf mistletoe may involve isolation of infested trees, selective removal of infested trees, or growing only non-host trees beneath and among infested host trees.

C. Insects -- Western pine beetle attacks old-growth ponderosa pine. Mountain pine beetle also attacks ponderosa pine. Much of the mortality in small patches that set a template for the small even-aged patches in the pre-settlement landscape was probably due to western pine beetle attacks on old ponderosa pine.

Bark beetles are small insects which lay eggs in the inner bark of trees. Bark beetle attack and kill the host trees. Some species and sizes of trees are more susceptible to bark beetles. Treatment for bark beetles includes managing susceptible stands to reduce their likelihood of coming under attack by bark beetles. Altering unattacked stands is more effective for controlling beetle populations than treatment of attacked trees which are still occupied by beetles.

D. Grazing -- Over-grazing affects forage (both in terms of species and amounts). The native bunchgrasses decrease with grazing pressure and undesirable exotic species and annuals, especially cheatgrass, increase with grazing pressure. Bunchgrasses are most damaged by grazing from flowering to seed ripening (about mid April-July?). Grazing introduces noxious weeds. Grazing will result in degradation or elimination of biotic crust where present. Riparian zones are preferentially used by cattle and are negatively affected in multiple aspects by over-grazing. Bitterbrush is heavily browsed by cattle and deer in the winter.

E. Logging -- Low-value trees and low volumes make artificial regeneration economically impractical; natural regeneration is very slow and sparse due to stressful conditions (too warm, dry). Winter access can promote soil compaction and displacement unless ground is frozen. Thinning of smaller trees followed by prescribed underburns have potential to restore healthier conditions more in tune with a natural disturbance regime.

SILVICULTURAL REGIME:
1) Unevenaged management.
2) Harvest 30% of the volume on a 30 year re-entry cycle.
3) Favor Ponderosa Pine.

PRODUCTIVITY: Low productivity for trees. Site index is low (ponderosa pine mean 68-70 or lower, Douglas fir mean 65-66). Herbage production is excellent where the native bunch grass understory has been maintained and is naturally lower where bearberry is important in the understory. Herbage production is reduced by over-grazing. Natural regeneration of trees is slow. Mesic sites or micro sites within the zone will tend toward overstocking of trees in the absence of frequent fire.

LANDSCAPE SETTING: Elevation ranges from 2400 to 4800 feet. Aspects range from east to west; slopes from 12% to 68%. Slope position ranges from ridge top to lower slope.

GEOLOGY/SOILS: Soils are generally derived from granitic glacial till or outwash. Soil texture is sandy loam to sand.

CLIMATE/MOISTURE: The warmest and driest of the forested zones. Slightly cooler, with more precipitation, than the steppe zone. Warmer and often drier than the mesic Douglas fir zone. Evapotranspiration and soil water deficits are significant.

The specific plant associations contained within this zone on the Loomis State forest are as follows:

ponderosa pine/bitterbrush
ponderosa pine-Douglas fir/beardless bluebunch wheatgrass
Douglas fir/bitterbrush-bearberry

## DOUGLAS FIR ZONE:

The Douglas fir zone is the most widespread vegetation zone found in the Loomis Block. Douglas fir is the climax tree species on these zonal sites. Ponderosa pine is the major seral species on most sites. It is likely that ponderosa pine woodland maintained by frequent fire was a significant cover type within the zone. Undergrowth varies from bunch grass on drier habitats to snowberry thickets on relatively moist habitats. Dry slopes are often dominated by mountain big sagebrush. These sagebrush communities are widespread on dry south and west-facing slopes. Aspen and cottonwood occur along streams and other wetland areas. Engelmann spruce may also occur along streams where cold air drains near the upper elevations of the zone. An isolated population of Rocky Mountain Juniper occurs in Toats Coulee (below Juniper Point). This zone encompasses the Mixed Conifer habitat in the Loomis Wildlife Resource Workshop Report.

STRUCTURE: Semi-open, but relatively continuous, tree canopy. Stand structure quite variable due to variability in fire regime and recent fire suppression. Three general structural types may be described that represent points on a continuum: (1) park-like stands resembling those in ponderosa pine zone, (2) more dense single-layer canopies with relatively few smaller or larger trees, and (3) broken upper canopy of tall trees with shorter, more dense main canopies, with or without prominent subcanopy (multi-layered structure). Park-like structure probably was a major type in the pre-settlement landscape, but it is now mostly gone because of fire suppression. Understory is dominated by shrubs and/or grasses, and may be limited by dense tree growth.

SPECIES COMPOSITION: Douglas fir is the dominant late-seral (understory) tree species throughout this zone. The canopy (overstory) may be dominated by one or more of the following species: ponderosa pine, Douglas fir, western larch, or lodgepole pine. Ponderosa pine tends to be more important at lower elevations (warmer), and western larch and lodgepole pine are more important at higher elevations (cooler). Wide variety of shrub species reflects variability of site conditions within the zone. Important shrubs include bearberry, Snowbrush, pachistima, shiny-leaf spirea, ninebark, common snowberry, and mountain snowberry. Abundant common snowberry indicates the warm, moist extreme of this zone, bordering on the ponderosa pine zone. Pinegrass is a major understory dominant throughout much of this zone. Many species of forbs may be present, but none with very high constancy or cover.

DISTURBANCE

A. Fire -- Fire regimes characterized by a mixture of frequent, low-severity fire and less frequent, moderate to high severity fire (primarily low-severity fire regime). Typical pre-settlement fire return intervals were probably 10-50 yr. Frequent fire tends to favor ponderosa pine over Douglas fir, which is less fire-resistant. Open park-like structure favored by frequent, low-severity fire. Fire suppression, combined with some management practices (e.g., high-grade logging), has resulted in dense young canopy layers and ladder fuels, which in turn have increased the probability of stand-replacement high-severity fires and insect/disease outbreaks. Snowbrush increases after fire from buried seed. Most

shrubs and grasses resprout after fire.

B. Disease -- Phellinus weirii in Douglas fir causes root rot pockets; dwarf mistletoe abundant in Douglas fir; Armilleria root rot can affect all species.

Root diseases or root rot are caused by pathogenic fungi which occupy dead, buried root material. Susceptible trees are slowly killed after their growing roots contact infested material. Treatment may involve removing susceptible trees from the site and replacing them with resistant tree species.

C. Insects -- Western pine beetle attacks older ponderosa pine; mountain pine beetle attacks lodgepole and ponderosa pines. Douglas fir tussock moth and western spruce budworm attack Douglas fir periodically; this has been a major reason to discriminate against Douglas fir in management. Insect problems have been increased by fire suppression which has favored Douglas fir and created more dense stands where individual trees have lower vigor.

The Douglas-fir tussock moth is a caterpillar/moth which feeds on the foliage of Douglas-fir, grand fir and subalpine fir. Outbreaks develop quickly and can cause extensive tree growth loss, damage, and mortality before the epidemic subsides in a four year period. Human health risks are associated with outbreaks because of toxic compounds in the caterpillar hairs. Overcrowded pure host stands on warm, dry sites are the most susceptible condition. Maintaining individual tree vigor and favoring pine on dry sites reduces risk.

The western spruce budworm is a caterpillar/moth which feeds on the new growth of Douglas-fir, subalpine fir and Engelmann spruce. Periodic epidemics of this native insect cause tree growth losses, defects, and mortality. The most susceptible stands have multiple layers of pure host species, providing windblown caterpillars plenty of food. Treatments to reduce budworm susceptibility favor non-host species such as pines and reduce canopy layering.

See subalpine fir/lodgepole pine section for discussion of pine beetles.

D. Grazing -- Understory composition is more resistant to alteration by grazing than in ponderosa pine zone; however, pinegrass will decrease under heavy grazing pressure and certain forbs may increase (e.g., luina). Dense tree cover will decrease pinegrass production which is the major grass forage.

E. Silviculture -- Natural regeneration may be successful in some circumstances, but is not always reliable due to heat/drought stress, competition, or frost. Competition from pinegrass can be a serious impediment to regeneration - prompt planting is recommended where pinegrass is abundant. On some sites, shrub competition may be a problem. Soil compaction occurs if logging is done on wet ground. Frost generally not a problem, except on some higher elevation sites. Thinning of smaller trees followed by prescribed underburns has potential to restore healthier conditions more in tune with natural disturbance regime where future losses from pests and fire will be less.

F. Rodents -- Post-harvest shrub fields are subject to rodent damage.

SILVICULTURAL REGIME

1) Shelterwood Harvest favor Ponderosa Pine
    a) For timber production, retain 10 trees per acre.
    b) For late successional characteristics, retain 18 trees per acre, greater than 18 inches dbh if possible.
2) Rotation age is 90 years.
3) Ten year regeneration lag.
4) No pre-commercial thinning.
5) No commercial thinning.
6) Final harvest shelterwood (retain either 10 or 18 trees per acre)

PRODUCTIVITY: Productivity is generally moderate, but can be relatively good (e.g., PSME/SYAL association) or relatively poor (e.g., PSME/ARUV). Site index: ponderosa pine = 59-100; Douglas fir = 57-98; western larch = 43-87; lodgepole pine = 27-72. Initial tree growth may be slow on higher elevation sites. Grazing forage production is good on PSME/CARU association and generally fair elsewhere.

LANDSCAPE SETTING: Elevation 2240-5290 feet; all aspects; flat to steep (74%) slopes. This zone tends to occur on north aspects at lower elevations and on south aspects at higher elevations.

GEOLOGY/SOILS: Parent materials are variable, including glacial till and outwash, colluvium, and alluvium. Soil texture is generally sandy loam to sand, with abundant coarse fragments. Soil moisture is higher than in ponderosa pine zone because of greater precipitation and/or less solar insolation. Soil organic matter may accumulate because of lower soil temperatures. Drought is less important than in ponderosa pine zone, but still may be significant on some sites.

CLIMATE/MOISTURE: Overall, the zone could be considered moderately dry and moderately warm. Precipitation is equivalent to or somewhat greater than in the ponderosa pine zone. Temperatures are intermediate between upper and lower zones, although there is considerable variation in temperatures within this zone. This zone is warmer and/or more moist than the ponderosa pine and steppe zones, more dry than the mesic and wet subalpine fir zones, and warmer than the dry subalpine fir/cold Douglas fir zone.

The specific plant associations contained within this zone on the Loomis State forest are as follows:

Douglas fir/pinegrass
Douglas fir/common snowberry
Douglas fir/mountain snowberry
Douglas fir/pachistima
Douglas fir/bearberry
Douglas fir/ninebark

## SUBALPINE FIR and SUBALPINE FIR/LODGEPOLE PINE ZONES:

The high elevation forests of the Loomis Block form the subalpine fir zone. It is characterized by deep winter snow packs and relatively short, cool growing seasons. This is the second most widespread zone on the Block. Subalpine fir and or Engelmann spruce are the climax dominates. Major seral tree species include Douglas fir, western larch, lodgepole pine, and aspen. Ponderosa and western white pine may occur in limited numbers. Larch and Douglas fir will dominate on sites where catastrophic burns generally occur more than 200 years apart.

In the Subalpine fir/Lodgepole pine zone, lodgepole pine forms pure stands. At high elevations it may represent an edaphic or fire climax, where either soils are too poor to support more demanding species or the disturbance is to frequent to allow other species to establish. Lodgepole pine seems to dominate forests where catastrophic burns occur at intervals less than 200 years (Williams and Lillybridge 1983).

Many of these drier forests may have had frequent underburns which maintained park-like stands of large Douglas fir or larch with pinegrass and the dominant undergrowth. Common undergrowth species include pinegrass, dwarf-huckleberry, twinflower, low huckleberry, and cascades azalea. At higher elevations in this zone, Labrador tea and grouse huckleberry are major forest undergrowth species. Mountain big sagebrush communities occur on dry, south and west-facing slopes.

The subalpine zone also for RMZ park and woodland areas at upper timberline. It mainly occurs near Chopaka Mountain, although it is very extensive on adjacent US Forest Service land. Forests and woodlands are characterized by Engelmann spruce. Under riparian conditions, spruce for RMZ a stable old growth climax, occupying 80% or more of the basal Area. Subalpine fir is generally absent. Whitebark pine or subalpine larch may occur as persistent, seral trees at the highest forest elevations. Grouse huckleberry and skunk-leaf polemonium are common forest undergrowth species. The subalpine parkland is characterized by extensive grass, sedge, and forb dominated meadows. Shrubby willows dominated riparian and some wetland vegetation.

## SUBALPINE FIR ZONE:

STRUCTURE: Relatively dense forest dominated by a single main canopy layer. Varying development of subcanopy/regeneration layers depending on time since last disturbance and initial stocking pattern. Some stands may have a scattered upper canopy layer of larger trees over the dense main layer. The stand age structure variable and may be even-aged, all-aged, or multi-cohort. Shrub understory can be dense in early stages of succession; may become relatively sparse in middle stages of succession because of canopy shading. Grasses and forbs generally less important than shrubs, but usually present. Heavy litter accumulations on the ground.

SPECIES COMPOSITION: Major late-successional tree species is subalpine fir, which may take some time to occupy the site after a major disturbance. Engelmann spruce may also be an important late successional species (ABLA2/LIBOL association). The main canopy is dominated by one or more of the following: Douglas fir, western larch, lodgepole pine, Engelmann spruce, and, least commonly, subalpine fir. Major understory species include huckleberries (4 species), twinflower, pachistima, shiny-leaf spirea, and pinegrass. Huckleberry in abundance indicates cooler temperatures within this zone.

DISTURBANCE

A. Fire -- Fire regime typified by relatively infrequent, high-severity fires, and on some sites somewhat more frequent, moderate-severity fires (primarily high-severity fire regime). Mean fire return intervals probably 70-300 yr. Fires are either stand-replacement events, or partial-mortality events that considerably thin the canopy. Douglas fir and western larch are the only trees that survive fire regularly. High-severity fires at less than 200 year intervals favor dominance by lodgepole pine. Less intense fires favor dominance by Douglas fir or western larch. Subalpine fir and Engelmann spruce increase in importance with less frequent fire. Most understory species resprout after fire.

B. Disease -- Fallowness weirii root rot in Douglas fir; dwarf mistletoe in Douglas fir, western larch, subalpine fir.

Root diseases or root rot are caused by pathogenic fungi which occupy dead, buried root material. Susceptible trees are slowly killed after their growing roots contact infested material. Treatment may involve removing susceptible trees from the site and replacing them with resistant tree species.

C. Insects -- Western spruce budworm attacks Douglas fir, subalpine fir, Engelmann spruce. Mountain pine beetle attacks lodgepole pine, and creates major economic damage. Larch casebearer attacks western larch.

The western spruce budworm is a caterpillar/moth which feeds on the new growth of Douglas-fir, subalpine fir and Engelmann spruce. Periodic epidemics of this native insect cause tree growth losses, defects, and mortality. The most susceptible stands have multiple layers of pure host species, providing windblown caterpillars plenty of food. Treatments to reduce budworm susceptibility favor non-host species such as pines and reduce canopy layering. See subalpine fir/lodgepole pine section for discussion of pine beetles.

The larch casebearer is a non-native caterpillar/moth which feeds on the foliage of larch. Healthy larch trees can withstand severe infestation for four or more years before mortality is threatened. The casebearer may weaken trees so they die from other causes. Introductions of natural parasites have reduced the impact of larch casebearer on forests.

D. Grazing -- Grazing is not too important in this zone, but could be very destructive in riparian areas.

E. Silviculture -- Logging can damage soils if done on moist soils (compaction and displacement). Heavy equipment can compact soils. Frost damage to regeneration can be a problem in frost pockets created by tree removal. Competition from pinegrass or shrubs can also limit regeneration, so prompt reforestation is recommended. If a high water table is present, tree removal may result in water at the surface, due to reduced evapotranspiration, and attendant regeneration difficulties.

SILVICULTURAL REGIME:

1) Shelterwood harvest favor Douglas-fir and western larch.
    a) For timber production, retain 10 trees per acre.
    b) For late successional characteristics, retain 18 trees per acre greater than 18 inches dbh if possible.
2) Rotation age is 80 years.
    a) 80 years for timber production.
    b) 100 years for late successional characteristics.
3) No regeneration lag.
4) Pre-commercial thinning at age 30.
5) Commercial thinning at age 50 if economically feasible.
6) Final harvest, shelterwood (retain 10 or 18 trees per acre).

PRODUCTIVITY: The most productive forest zone, on average. Stands are relatively easy to regenerate. Site index: western larch = 93-100, Douglas fir = 67-102, lodgepole pine = 57-85, subalpine fir = 67-92, Engelmann spruce = 54-129. Huckleberry understory indicates cooler, less productive end of zone. Dense stocking common.

LANDSCAPE SETTING: Elevation ranges from 2170 to 5940 feet. All aspects. Slopes flat to steep (maximum 61%). Slope position variable.

GEOLOGY/SOILS: Parent materials are variable, and often mixed, including glacial till and outwash, alluvium, and volcanic ash. Soil texture is silt loam to sand, on average finer than in Douglas fir or ponderosa pine zones. Ground water may be relatively near the surface on some sites.

CLIMATE/MOISTURE: Moderate to cool, moist climate. Snowpack is a significant winter feature here, which may last for some months on the cooler sites. Precipitation is relatively high. This zone is drier than the wet subalpine fir zone, more moist than the mesic Douglas fir zone, and warmer and/or more moist than the dry subalpine fir zone.

The specific plant associations contained within this zone on the Loomis State forest are as follows:

subalpine fir/twinflower
subalpine fir/huckleberry
subalpine fir/pachistima
subalpine fir/Cascade azalea

Engelmann spruce/horsetail
Douglas fir/huckleberry
subalpine fir/pinegrass
subalpine fir/pinegrass/grouse huckleberry

**SUBALPINE FIR/ LODGEPOLE PINE ZONE:**

STRUCTURE: Relatively dense single-layer tree canopy with varying development of subcanopy based mainly on age of the stand. Age structure consists of post-fire cohort and then potentially broad spread of understory regeneration. Trees are relatively small and often over stocked. Understories are dominated by short shrubs. Many relatively small snags and logs are typical of mature to old stands. This is lynx habitat.

SPECIES COMPOSITION: Subalpine fir and/or Engelmann spruce are the late-successional tree species. The main canopy is dominated primarily by lodgepole pine and secondarily by Engelmann spruce. Subalpine fir generally only becomes important in the canopy in old stands. Understory vegetation is dominated by grouse huckleberry, with low huckleberry co-dominant about half the time.

DISTURBANCE

A. Fire -- High-severity fire regime typified by somewhat infrequent, high severity fires. Mean fire return intervals in the pre-settlement landscape were probably 100-200 years. Almost all trees are killed by fires when they do occur. Lodgepole pine has a significant degree of serotiny here, allowing it to rapidly reseed burned areas by cones opened in the heat of the fire. Generally, lodgepole remains a significant component of the canopy for about 200 years after fire, at which time it become uncommon due to mountain pine beetle-induced mortality. Natural fire cycles favored the maintenance of extensive lodgepole pine stands because fire generally returned prior to the loss of lodgepole as a dominant from the stand. Fire-sensitive subalpine fir has been kept from dominating by fires.

B. Disease -- unknown

C. Insects -- Mountain pine beetle is a major mortality agent for lodgepole pine. If pine are not killed by fire, they are generally killed by beetles. Beetle mortality generally will become significant about 100 years after a fire.

Bark beetles are small insects which lay eggs in the inner bark of trees. Bark beetle attack and kill the host trees. Some species and sizes of trees are more susceptible to bark beetles. Treatment for bark beetles includes managing susceptible stands to reduce their likelihood of coming under attack by bark beetles. Altering unattacked stands is more effective for controlling beetle populations than treatment of attacked trees which are still occupied by beetles.

D. Silviculture -- Frost hazard is extreme from re-radiation cooling and cold air drainage. Removal of upper soil horizons by logging or other damage may severely reduce nutrient availability and productivity. Clearcutting and burning may leave site so exposed to

environmental stress that regeneration is difficult. Snags and logs may be important to maintaining 'safe sites' for tree regeneration. Soil compaction possible with heavy equipment. Many overstocked stands need to be thinned in order to maintain reasonable growth rates on individual trees.

SILVICULTURAL REGIME:
1) Evenage harvest (retain 10 trees per acre)
2) 10 year regeneration lag, natural regeneration.
3) No pre-commercial thinning.
4) Commercial thin if economically feasible at age 50
5) Rotation age is 80 years.

PRODUCTIVITY: This zone has low productivity due to short growing season and cold conditions year-round. Site index: lodgepole pine = 31; Engelmann spruce = 36. Overstocking can be a problem. Little forage here for grazing.

LANDSCAPE SETTING: Elevation range 5500-7000 feet. Aspect variable. Slopes mostly moderate (mean 21%, range 3-65%). Slope position mostly mid to upper slope.
SOILS: Parent material mostly granitic glacial till. Soil texture sandy loam to sand. Soils are cold, acid, shallow, doughty, and poorly developed.

CLIMATE/MOISTURE: Cold and moderately dry. Frost or snow is possible any day of the year. Significant winter snowpack. Colder than mesic or dry subalpine fir zones; colder and drier than wet subalpine fir zone; warmer, more moist, or more dry than subalpine parkland/alpine zone.

The specific plant associations contained within this zone on the Loomis State forest are as follows:

subalpine fir/grouse huckleberry-pinegrass
subalpine fir/grouse huckleberry
subalpine fir/pinegrass

**ALPINE ZONE:**

The alpine zone is the highest zone; it is a minor component in the Loomis Block. It occurs above tree-line on Chopaka Mountain within the Loomis Block. Extensive areas of alpine are widespread in the Pasayten Wilderness and Tiffany Mountains. Sedge, grass, and forb communities dominate (Douglas and Bliss 1977).

Associated with the alpine areas are non-riparian Quaking aspen forest types throughout the higher elevations of the Loomis State forest. These areas have little evidence of conifer regeneration and often adjoin wet meadows or other edaphic feature that limits conifer growth. Understories consist of common snowberry or pinegrass. These areas likely are successionally stable and represent a climax community of aspen.

STRUCTURE: Non forest or aspen grove. This zone includes 3 main structural types: (1) open-canopy subalpine forest or aspen grove, (2) parkland of subalpine meadows in a mosaic with scattered trees or tree clumps, (3) alpine vegetation with no upright trees. Trees are relatively small and poorly formed. Alpine vegetation and subalpine meadows are generally dominated by herbs, especially graminoids. Short shrubs are important in certain types of forest, parkland, or alpine. 'Krummholz' thickets of trees are a common feature of this zone. Krummholz cannot assume an upright form due to winter stresses above the snowpack. This is a variable high-elevation zone.

SPECIES COMPOSITION: Open forests and parklands may have one or more of the following important tree species: subalpine larch, Engelmann spruce, subalpine fir, whitebark pine, quaking aspen and lodgepole pine. Subalpine larch and whitebark pine are limited primarily to this zone and occur higher than any other trees. Open forest understories are generally dominated by one or more of the following species: pinegrass, red mountain-heather, moss-heather, common snowberry, grouse huckleberry, and smooth woodrush. Many subalpine meadow and alpine community types may be present: some of the more important dominants are probably green fescue, sedges, kobresia, timber danthonia, and common juniper. Mountain big sagebrush may codominate some parkland meadows.

DISTURBANCE

A. Fire -- Fire regimes not well known. Forest and parkland portions probably do burn infrequently and at high severity. Maybe considerable variability in fire regimes within this zone. Whitebark pine forests are the most likely to burn on a more frequent basis. Alpine areas may never burn. Fire regime altered where grazing has reduced herbaceous fuels. Fire not necessarily a 'disaster' here as some might expect. Trees can be naturally slow to establish after fires, taking up to 100 years to stock a formerly open forest. In some cases, fires can convert open stands to semi-permanent meadows. Conversely, some meadows slowly fill in with trees. A slow dynamism appears to be natural here.

B. Disease -- White pine blister rust attacks whitebark pine, and could extirpate the species.

C. Insects -- None of economic significance. Mountain pine beetle attacks whitebark and lodgepole pines.

D. Grazing -- Parklands and alpine have been used by sheep. Grazing alters species composition, introduces exotic species which are likely to increase with grazing pressure.

E. Silviculture -- Very poor economic return for degree of ecological disturbance inflicted by logging here. Regeneration is difficult because of frost damage, long-duration snowpacks. Natural regeneration very slow. Compaction and erosion is of concern. No logging entry is recommended in this zone.

PRODUCTIVITY: Timber productivity is very poor. Trees grow very slowly. Short growing season and low temperatures limit productivity.

LANDSCAPE SETTING: Elevations above 5810 feet. Aspects, slopes, slope positions various. At lower end of zone, tends to occur on steep, southerly aspects on upper slopes to ridgetops, or moderate northerly aspects with deep, long-duration snowpack.

SOILS: Parent materials are bedrock or glacial till. Soils are shallow, cold, poorly developed.

CLIMATE/MOISTURE: Coldest zone. Dry to wet moisture conditions. Wind is a significant factor, especially in winter when blowing snow and ice crystals contribute to winter desiccation. Very short growing season. Long-duration snowpack. Extreme frost heaving once snow is gone.

The specific plant associations contained within this zone on the Loomis State forest are as follows:

whitebark pine/pinegrass
subalpine larch
subalpine fir/red mountain heather
green fescue
mountain big sagebrush
sedge-kobresia
timber danthonia-sedge
quaking aspen/common snowberry
quaking aspen/pinegrass
other subalpine parkland and alpine associations